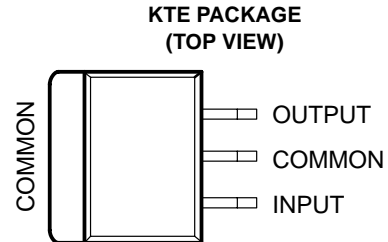
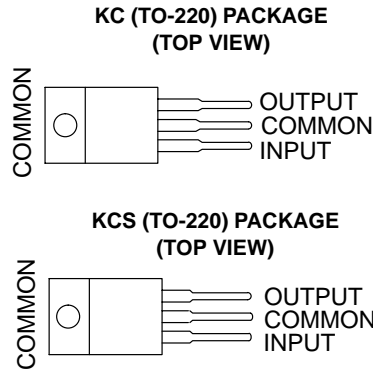


# TL780 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS055J – APRIL 1981 – REVISED MAY 2003

- $\pm 1\%$  Output Tolerance at  $25^{\circ}\text{C}$
- $\pm 2\%$  Output Tolerance Over Full Operating Range
- Thermal Shutdown
- Internal Short-Circuit Current Limiting
- Pinout Identical to  $\mu\text{A}7800$  Series
- Improved Version of  $\mu\text{A}7800$  Series



## description/ordering information

Each fixed-voltage precision regulator in the TL780 series is capable of supplying 1.5 A of load current. A unique temperature-compensation technique, coupled with an internally trimmed band-gap reference, has resulted in improved accuracy when compared to other three-terminal regulators. Advanced layout techniques provide excellent line, load, and thermal regulation. The internal current-limiting and thermal-shutdown features essentially make the devices immune to overload.

## ORDERING INFORMATION

$T_J$	$V_O$ TYP (V)	PACKAGE†		ORDERABLE PART NUMBER	TOP-SIDE MARKING
$0^{\circ}\text{C}$ to $125^{\circ}\text{C}$	5	Power Flex (KTE)	Reel of 2000	TL780-05CKTER	TL780-05C
		TO-220 (KC)	Tube of 50	TL780-05CKC	TL780-05C
		TO-220, short shoulder (KCS)	Tube of 20	TL780-05CKCS	
	12	TO-220 (KC)	Tube of 50	TL780-12CKC	TL780-12C
		TO-220, short shoulder (KCS)	Tube of 20	TL780-12CKCS	
	15	TO-220 (KC)	Tube of 50	TL780-15CKC	TL780-15C
		TO-220, short shoulder (KCS)	Tube of 20	TL780-15CKCS	

† Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at [www.ti.com/sc/package](http://www.ti.com/sc/package).



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PRODUCTION DATA information is current as of publication date. Products conform to specifications per the terms of Texas Instruments standard warranty. Production processing does not necessarily include testing of all parameters.

**TEXAS  
INSTRUMENTS**

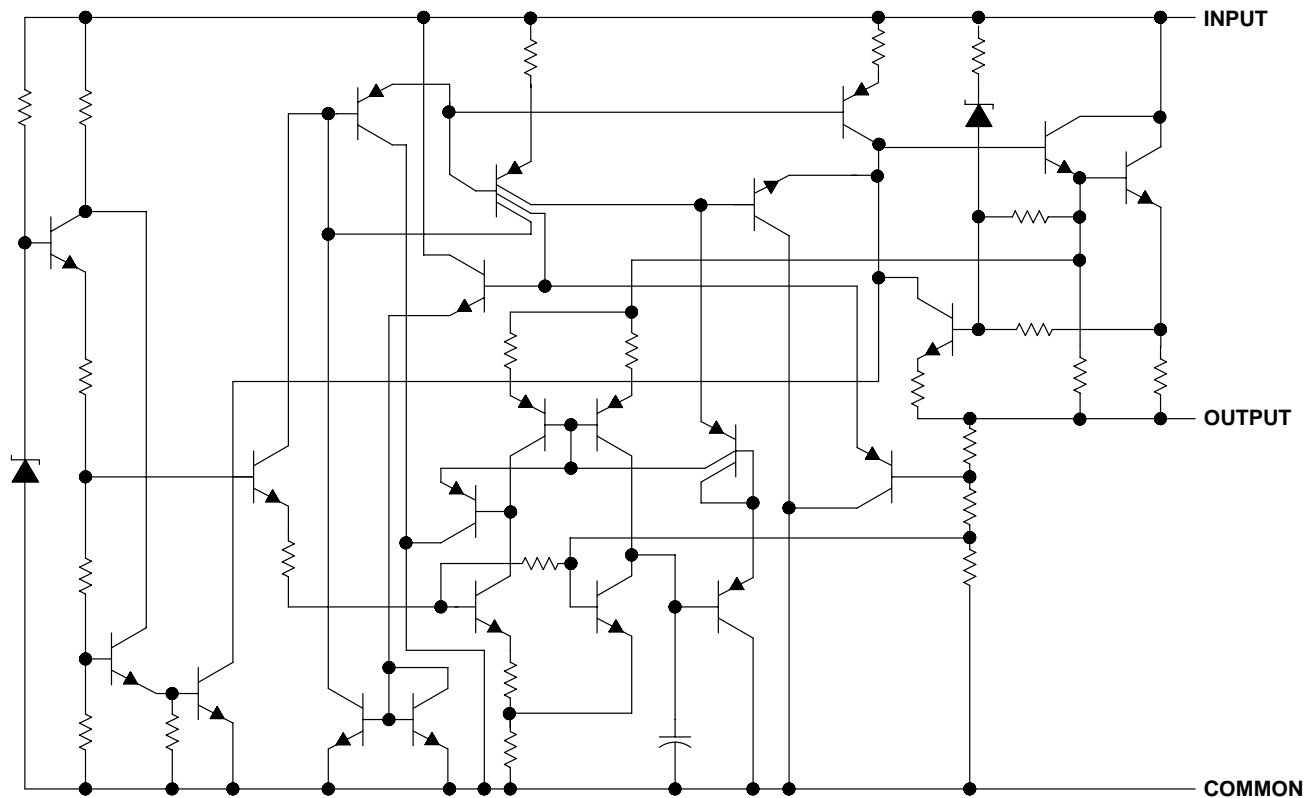
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TL780 SERIES  
POSITIVE-VOLTAGE REGULATORS

SLVS055J – APRIL 1981 – REVISED MAY 2003

schematic



absolute maximum ratings over operating temperature range (unless otherwise noted)<sup>†</sup>

Input voltage, $V_I$	35 V
Operating virtual junction temperature, $T_J$	150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C
Storage temperature range, $T_{stg}$	–65°C to 150°C

<sup>†</sup> Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

package thermal data (see Note 1)

PACKAGE	BOARD	$\theta_{JC}$	$\theta_{JA}$
Power Flex (KTE)	High K, JESD 51-5	3°C/W	23°C/W
TO-220 (KC/KCS)	High K, JESD 51-5	3°C/W	19°C/W

NOTE 1: Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of 150°C can impact reliability. Due to variations in individual device electrical characteristics and thermal resistance, the built-in thermal overload protection may be activated at power levels slightly above or below the rated dissipation.

# TL780 SERIES POSITIVE-VOLTAGE REGULATORS

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## recommended operating conditions

		MIN	MAX	UNIT
$V_I$ Input voltage	TL780-05C	7	25	V
	TL780-12C	14.5	30	
	TL780-15C	17.5	30	
$I_O$ Output current			1.5	A
$T_J$ Operating virtual junction temperature		0	125	°C

## electrical characteristics at specified virtual junction temperature, $V_I = 10$ V, $I_O = 500$ mA (unless otherwise noted)

PARAMETER	TEST CONDITIONS	$T_J$ †	TL780-05C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5$ mA to 1 A, $P \leq 15$ W, $V_I = 7$ V to 20 V	25°C	4.95	5	5.05	V
		0°C to 125°C	4.9		5.1	
Input voltage regulation	$V_I = 7$ V to 25 V	25°C		0.5	5	mV
	$V_I = 8$ V to 12 V			0.5	5	
Ripple rejection	$V_I = 8$ V to 18 V, $f = 120$ Hz	0°C to 125°C	70	85		dB
Output voltage regulation	$I_O = 5$ mA to 1.5 A	25°C		4	25	mV
	$I_O = 250$ mA to 750 mA			1.5	15	
Output resistance	$f = 1$ kHz	0°C to 125°C		0.0035		$\Omega$
Temperature coefficient of output voltage	$I_O = 5$ mA	0°C to 125°C		0.25		mV/°C
Output noise voltage	$f = 10$ Hz to 100 kHz	25°C		75		$\mu$ V
Dropout voltage	$I_O = 1$ A	25°C		2		V
Input bias current		25°C		5	8	mA
Input bias-current change	$V_I = 7$ V to 25 V	0°C to 125°C		0.7	1.3	mA
	$I_O = 5$ mA to 1 A			0.003	0.5	
Short-circuit output current		25°C		750		mA
Peak output current		25°C		2.2		A

† Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33- $\mu$ F capacitor across the input and a 0.22- $\mu$ F capacitor across the output.

# TL780 SERIES

## POSITIVE-VOLTAGE REGULATORS

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**electrical characteristics at specified virtual junction temperature,  $V_I = 19\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)**

PARAMETER	TEST CONDITIONS	$T_J^\dagger$	TL780-12C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $P \leq 15\text{ W}$ , $V_I = 14.5\text{ V to }27\text{ V}$	25°C	11.88	12	12.12	V
		0°C to 125°C	11.76		12.24	
Input voltage regulation	$V_I = 14.5\text{ V to }30\text{ V}$	25°C		1.2	12	mV
	$V_I = 16\text{ V to }22\text{ V}$			1.2	12	
Ripple rejection	$V_I = 15\text{ V to }25\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	65	80		dB
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		6.5	60	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			2.5	36	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.0035		$\Omega$
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		0.6		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		180		$\mu\text{V}$
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V
Input bias current		25°C		5.5	8	mA
Input bias-current change	$V_I = 14.5\text{ V to }30\text{ V}$	0°C to 125°C		0.4	1.3	mA
	$I_O = 5\text{ mA to }1\text{ A}$			0.03	0.5	
Short-circuit output current		25°C		350		mA
Peak output current		25°C		2.2		A

$^\dagger$  Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33- $\mu\text{F}$  capacitor across the input and a 0.22- $\mu\text{F}$  capacitor across the output.

**electrical characteristics at specified virtual junction temperature,  $V_I = 23\text{ V}$ ,  $I_O = 500\text{ mA}$  (unless otherwise noted)**

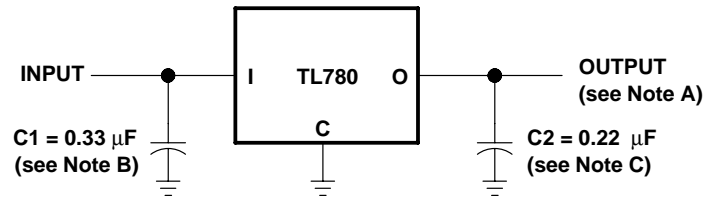
PARAMETER	TEST CONDITIONS	$T_J^\dagger$	TL780-15C			UNIT
			MIN	TYP	MAX	
Output voltage	$I_O = 5\text{ mA to }1\text{ A}$ , $P \leq 15\text{ W}$ , $V_I = 17.5\text{ V to }30\text{ V}$	25°C	14.85	15	15.15	V
		0°C to 125°C	14.7		15.3	
Input voltage regulation	$V_I = 17.5\text{ V to }30\text{ V}$	25°C		1.5	15	mV
	$V_I = 20\text{ V to }26\text{ V}$			1.5	15	
Ripple rejection	$V_I = 18.5\text{ V to }28.5\text{ V}$ , $f = 120\text{ Hz}$	0°C to 125°C	60	75		dB
Output voltage regulation	$I_O = 5\text{ mA to }1.5\text{ A}$	25°C		7	75	mV
	$I_O = 250\text{ mA to }750\text{ mA}$			2.5	45	
Output resistance	$f = 1\text{ kHz}$	0°C to 125°C		0.0035		$\Omega$
Temperature coefficient of output voltage	$I_O = 5\text{ mA}$	0°C to 125°C		0.62		mV/°C
Output noise voltage	$f = 10\text{ Hz to }100\text{ kHz}$	25°C		225		$\mu\text{V}$
Dropout voltage	$I_O = 1\text{ A}$	25°C		2		V
Input bias current		25°C		5.5	8	mA
Input bias-current change	$V_I = 17.5\text{ V to }30\text{ V}$	0°C to 125°C		0.4	1.3	mA
	$I_O = 5\text{ mA to }1\text{ A}$			0.02	0.5	
Short-circuit output current		25°C		230		mA
Peak output current		25°C		2.2		A

$^\dagger$  Pulse-testing techniques maintain the junction temperature as close to the ambient temperature as possible. Thermal effects must be taken into account separately. All characteristics are measured with a 0.33- $\mu\text{F}$  capacitor across the input and a 0.22- $\mu\text{F}$  capacitor across the output.



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**PARAMETER MEASUREMENT INFORMATION**



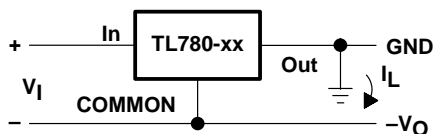
- NOTES: A. Permanent damage can occur when OUTPUT is pulled below ground.  
B. C1 is required when the regulator is far from the power-supply filter.  
C. C2 is not required for stability; however, transient response is improved.

**Figure 1. Test Circuit**

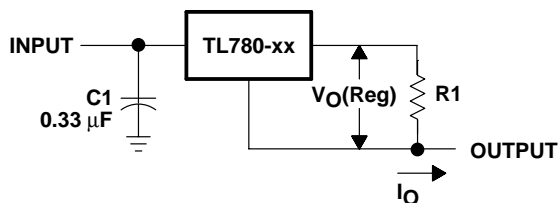
# TL780 SERIES POSITIVE-VOLTAGE REGULATORS

SLVS055J – APRIL 1981 – REVISED MAY 2003

## APPLICATION INFORMATION



**Figure 2. Positive Regulator in Negative Configuration ( $V_I$  Must Float)**

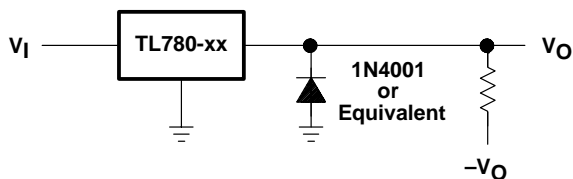


$$I_O = (V_O/R1) + I_O \text{ Bias Current}$$

**Figure 3. Current Regulator**

### operation with a load common to a voltage of opposite polarity

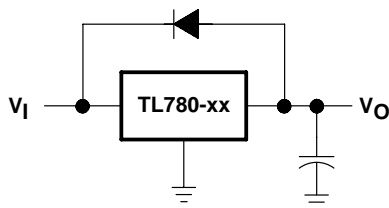
In many cases, a regulator powers a load that is not connected to ground, but instead, is connected to a voltage source of opposite polarity (e.g., operational amplifiers, level-shifting circuits, etc.). In these cases, a clamp diode should be connected to the regulator output as shown in Figure 4. This protects the regulator from output polarity reversals during startup and short-circuit operation.



**Figure 4. Output Polarity-Reversal-Protection Circuit**

### reverse-bias protection

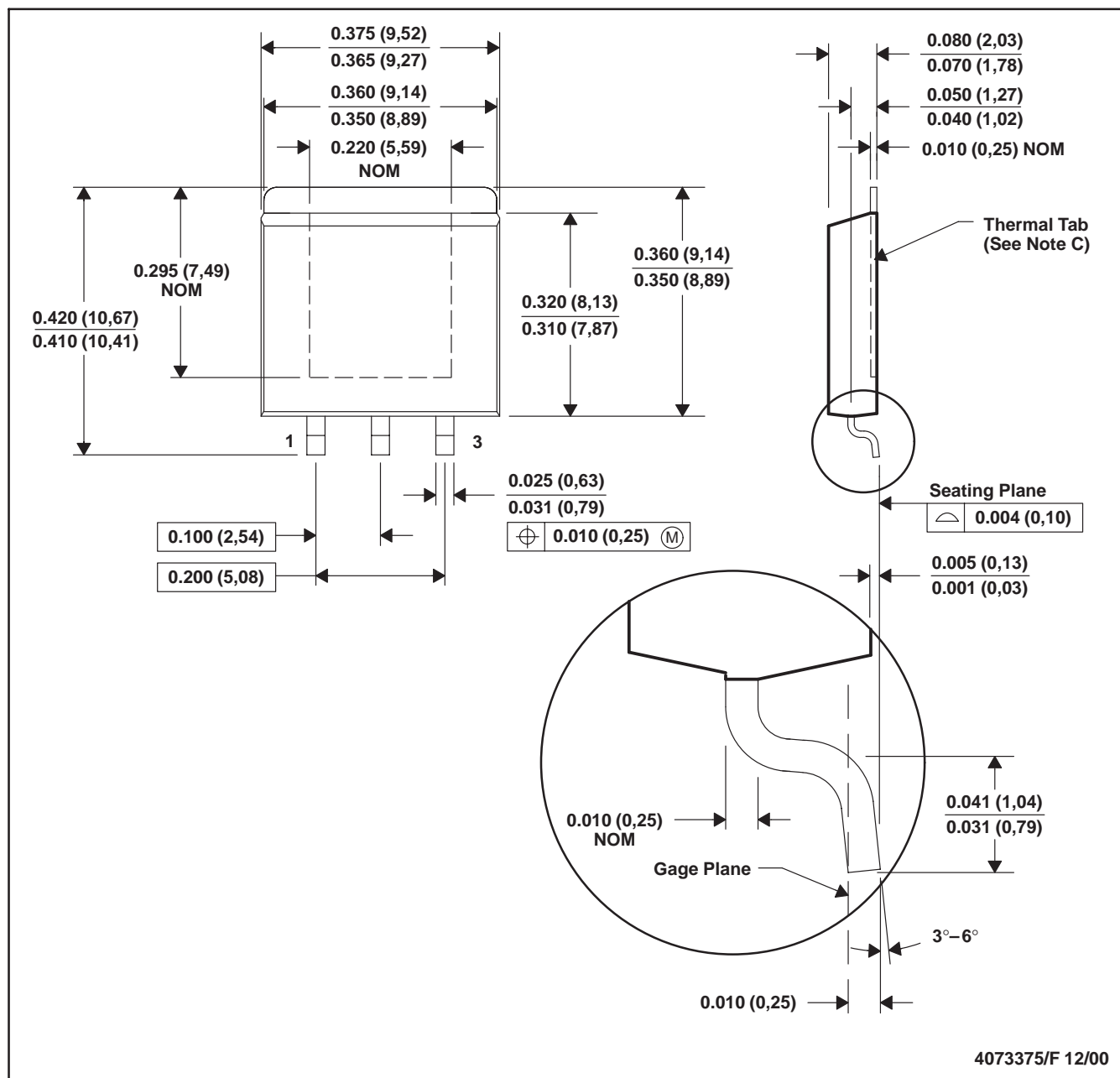
Occasionally, the input voltage to the regulator can collapse faster than the output voltage. This, for example, could occur when the input supply is crowbarred during an output overvoltage condition. If the output voltage is greater than approximately 7 V, the emitter-base junction of the series pass element (internal or external) could break down and be damaged. To prevent this, a diode shunt can be employed, as shown in Figure 5.



**Figure 5. Reverse-Bias-Protection Circuit**

## KTE (R-PSFM-G3)

## PowerFLEX™ PLASTIC FLANGE-MOUNT



- NOTES:
- All linear dimensions are in inches (millimeters).
  - This drawing is subject to change without notice.
  - The center lead is in electrical contact with the thermal tab.
  - Dimensions do not include mold protrusions, not to exceed 0.006 (0,15).
  - Falls within JEDEC MO-169

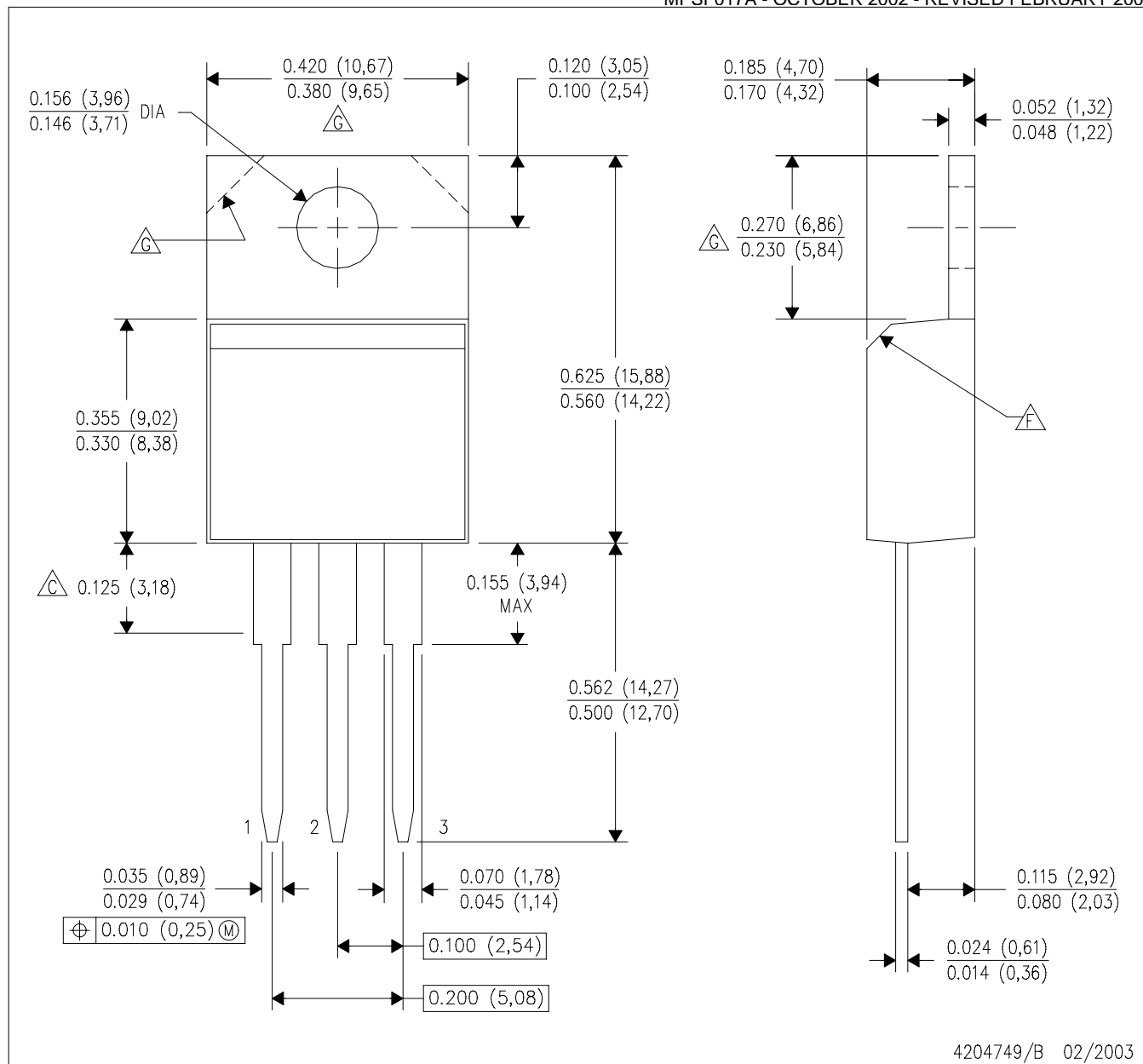
PowerFLEX is a trademark of Texas Instruments.



KCS (R-PSFM-T3)

PLASTIC FLANGE-MOUNT PACKAGE

MPSF017A - OCTOBER 2002 - REVISED FEBRUARY 2003



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Lead dimensions are not controlled within this area.
  - D. All lead dimensions apply before solder dip.
  - E. The center lead is in electrical contact with the mounting tab.
  - F. The chamfer is optional.
  - G. Tab contour optional within these dimensions.
  - H. Falls within JEDEC TO-220 variation AB.

SCALE

A  
SIZE

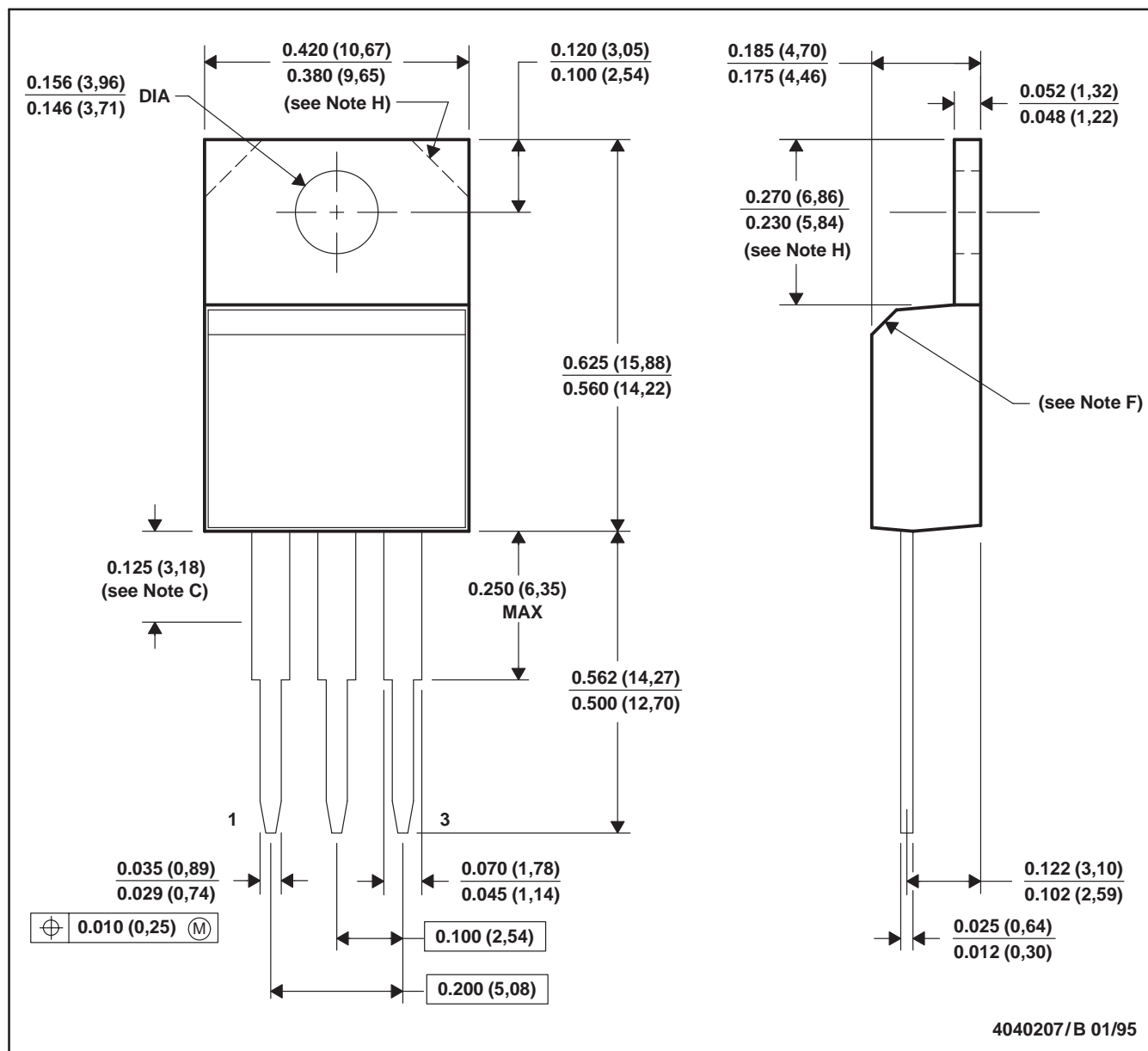
4204749

B  
REVSHEET  
2/3



## KC (R-PSFM-T3)

## PLASTIC FLANGE-MOUNT PACKAGE



- NOTES: A. All linear dimensions are in inches (millimeters).  
 B. This drawing is subject to change without notice.  
 C. Lead dimensions are not controlled within this area.  
 D. All lead dimensions apply before solder dip.  
 E. The center lead is in electrical contact with the mounting tab.  
 F. The chamfer is optional.  
 G. Falls within JEDEC TO-220AB  
 H. Tab contour optional within these dimensions

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